Automotive Mutimeter
ADD81/ADD91/ADD71

INSTRUCTION MANUAL

BEIJING ADD-TECH CO.,LTD

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ADD91/ADD81/ADD71

33/4 AUTOMOTIVE DIGITAL ULTIMETER
(AUTOMOTIVE SENSOR SIMULATOR AND TESTER)
OPERATION MANUAL

This instrument is a compact 、 battery operated、 handheld with safety protector 、streamline 、 3 3/ 4 digital automotive engine analyzer multimeter for measuring DC/AC Voltage, DC/ AC Current, Resistance, , Capacitance, Frequency and Duty cycle, Temperature, Diode/Continuity test Rachometer, Dwell .ms-PULSE,AnalogFrequency/Duty/Voltage/Resistance Signal Output ,It is an ideal instrument for automotive diagnostic .

Safety

DANGER

- Engines produce carbon monoxide which is odorless, causes slower reaction time .and can lead to serious injury .when the engine is operating keep service areas WELL VENTILATED or attach the vehicle exhaust system to the shop exhaust removal system.
- Set the parking brake and block the wheels before testing or repairing the vehicle .it is especially important to block the wheels on front-wheel drive vehicles: The parking brake dose not hold the drive wheels.
- Wear an eye shield when testing or repairing vehicles .exceeding the limits of this meter is dangerous, it will expose you to serious or possibly fatal injury .carefully read and understand the cautions and the specification limits of this meter.

- Voltage between any terminal and ground must not exceed 1000V DC or 750V AC.
- Use caution when measuring voltage above 25VAC or DC.
- Circuit tested must be protested by a 10A fuse or circuit breaker.
- Do not use the meter if it has been damaged
- Do not use the test leas if the insulation is damaged or metal is exposed.
- Use current clamps to measure circuits exceeding 10A.

Danger

- Avoid electrical shock ， do not touch the test leads ,tips or the circuit being tested.
- Do not try a voltage measurement with the test leads in the 10A or the mA terminal.
- When testing for the presence of voltage or current .make sure the meter is function correctly, take a reading of a known voltage or current before accepting a zero reading.
- Choose the proper range and function for the measurement .do not try voltage or current measurements that may exceed the ratings marked on the function/range switch or terminal.
- When measuring current. Connect the meter in series with the load.
- Never connect more than one set of test leads to the

meter.

- Disconnect the live test lead before disconnecting the common test lead.
- The mA and the 10A terminals are protected by fuse to avoid possible injury or damage .use only in circuits limited to 400mA or 10A continuous for 15 seconds .

See also

Fuse Replacement

IMPORTANT

- To maintain accuracy of the meter, replace the discharged battery immediately when the battery symbol appears on the meter display
- Avoid measuring error form outside interference: keep the meter away form spark plug or coil wires.
- Avoid damaging the meter when testing voltage: disconnect the test leads form the test points before changing functions.
- Do not exceed the limits shown in the table below:

Function	Terminal	Input Limit
AC Volts	V/Ω/RPM	750V AC rms
DC Volts		1000V DC
Frequency	V/Ω/RPM	250V AC/DC
Ohm (resistance)		
Diode		
AC/DC 400mA	mA	400mA AC/DC
AC/DC 10A	10A	*10A AC/DC
RPM	V/Ω/RPM	250V AC/DC

Duty Cycle(%)		
Dwell angle		

10Amp measurement continuous for 15 seconds maximum.

Ohm can not be measured if voltage is present , ohms can be measured only in a non-powered circuit .however ,the meter is protected to 250 volts.

SPECIFICATION
GENERAL SPECIFICATION

Display: 3-3/4 digits LCD with 25mm high numerals.

Auto Functions: Auto-zero, Auto-polarity, Auto-range

Auto power off: 30 minutes after stopping the switch or no push button, the meter enter to Power off mode. Push button or run switch, Auto Power off disable.

Low Battery Indication: "".

Over range Indication: "OL".

Power Supply: single 9V battery (NEDA 1604or IEC 6F22)

Reading Rate Time: 3 reading per sec(approx.).

Maximum Common Mode Voltage: 500Vdc or ac peak.

Safety Standards: The meter is up to the standards Of IEC1010 Double Insulation, Pollution degree 2 Over voltage Category Ⅱ.

Operating Environment: 0℃ to 50℃(32℉to 122℉) at ≤ 70% relative humidity.

Storage Environment: -20℃ to 60℃(-4℉ to 140℉) at ≤ 80% relative humidity .

Temperature Coefficient: 0.1×(specified accuracy)/℃（≤18℃ or≥28℃）

Accessories: One pair test leads, single 9V battery (NEDA 1604or IEC 6F22), operating instructions.

Fuse: 0.5A/250V, 5×20mm fast acting 10A/250V, 5×20mm or 5×25mm, fast acting.

Dimension : 155mm×97mm×50mm

Weight : Approx. 320g(including battery and holster).

Electrical specifications

*Accuracy is given as ±([% of reading]+[number of leads significant digits]) at 18℃ to 28℃(65℉ to 83℉),with relative humidity up to 70%.

RPM (Tach) (Only ADD91/ADD81)
Ranges:600-4000,4000-12000(×10RPM)
Resolution: 1 RPM
Effect reading : >600RPM
Accuracy:±(2.5%rdg+10dgt)

Overload protection: 250VDC or RMS AC
Pulse width (Only ADD91/ADD81)
Ranges: 0.1ms-10.0ms
Accuracy :±(2.5%+0.2ms)
Overload protection: 250VDC or RMS AC

% Duty cycle
Ranges: 0.0-90.0%
Resolution: 0.1%
Pulse width:>100us,<100ms
Accuracy:±(2.5%rdg+10dgt)

Overload protection: 250VDC or RMS AC

Dwell angle (Only ADD91/ADD81)
No. of cylinder: 4. 5.6.8
Range:0-90.0 ° (4 CYL),0-72.0 ° (5CYL),0-60.0 ° (6CYL),0-45.0 °(8CYL.)
Resolution:0.1 °
Accuracy:±(2.5%rdg+10dgt)
Overload protection: 250VDC or RMS AC

Temperature (Only ADD91/ADD81)
Ranges:-50 to 1100℃,-50 to 2000℉
Resolution:1℃/1℉
Accuracy:±(1%rdg+2℃)
±(1%rdg+4℉)
Sensor: type K thermocouple
Input protection: 60VDC or 24VAC rms

DC voltage (auto ranging)
Ranges: 400mV
Accuracy: ± (0.8%rdg+10dgt)
Ranges: 4V, 40V, 400V, 1000V
Accuracy: ± (0.5%rdg+5dgt)
Resolution: 100uV
input impedance:>10MΩ
Overload protection: 1000VDC or 750VAC rms.

AC VOLTAGE(Auto ranging)
Ranges: 400Mv, 4V, 40V, 400V, 750V,(400mV only in manual)
Resolution: 100uV
Accuracy: 400mV, 750V ± (1.8%rdg+10dgt) at 50Hz to 100Hz
4V, 40V, 400V, ± (1.5%rdg+10dgt) at 50Hz to 400Hz

input impedance:>10MΩ
Overload protection: 1000VDC or 750VAC rms.

DC CURRENT
Ranges: 400uA, 4000uA, 40mA, 400mA, 10A.
Resolution: 0.1uA
Accuracy: 400uA, 4000uA ±(1.2%rdg+5dgt)
40mA, 400mA ± (1.5%rdg+5dgt)
10A ± (2.0%rdg+10dgt)
Input protection: 0.5A/250V fuse on 400mA range
10A/250V high energy fuses on 10A range

AC CURRENT
Ranges: 400uA, 4000uA, 40mA, 400mA, 10A.
Resolution: 0.1uA
Frequency response: 50Hz to 400Hz
Accuracy: 400uA, 4000uA ±(1.8%rdg+5dgt)
40mA, 400mA ±(1.8%rdg+10dgt)
10A ±(2.5%rdg+10dgt)
Input protection: 0.5A/250V fuse on 400mA range
10A/250V high energy fuses on 10A range

RESISTANCE (Auto ranging)
Ranges:400Ω,4KΩ,40KΩ,400KΩ,4MΩ,40MΩ
Accuracy:±(1.2%rdg+10dgts) on 400Ω range
±(1.0%rdg+5dgts) on 4kΩ to 4MΩ ranges
±(2.5%rdg+15dgts) on 40MΩ ranges
open circuit voltage: 0.4VDC
overload protections: 250VDC or RMS AC.

FERQUENCY (Auto ranging)
Ranges: 100Hz, 1 KHz, 100 KHz, 200 KHz
Resolution: 0.01Hz

Accuracy: ±(0.1%rdg+5dgts)
Sensitivity: 1V
Overload protection: 250VDC or RMS AC

CAPACITANCE (Auto ranging)
Ranges: 40nF, 400nF, 4uF, 40uF, 100uF.
Resolution: 10pF
Accuracy:±(2.5%rdg+10dgts) on 40nF range
±(1.5%rdg+10dgts) on 400nF to 4uF ranges
±(2.5%rdg+15dgts) on 40uF to100uF ranges
Overload protection: 250VDC or RMS AC

DIODE TEST
Test current: 0.6mA typical
Resolution: 1mV
Accuracy:±(2.5%rdg+2gdts)
Open circuit voltage: 3.0Vdc typical
Overload protection: 250VDC or RMS AC.

AUDIBLE CONTINUITY
Open circuit voltage: 0.4Vdc
≤60Ω Buzzer sounds
Overload protections n: 250VDC or RMS AC.

Signal analog Output (Analog Frequency/Duty/Voltage Signal Output)(Only ADD91)
FREQUENCY: 20Hz-4 KHz
% Duty cycle: 10%-90%
VOLTAGE: 0-5V
Signal analog Output (Analog Frequency/Duty/DC and AC Voltage/RESISTANCE Signal Output)(Only ADD71)
FREQUENCY: 20Hz-3 KHz
% Duty cycle: 10%-90%

DC VOLTAGE:0-1V、0-5V、0-12V
AC VOLTAGE: 0-5V、0-12V
RESISTANCE: 0-5KΩ,0-200KΩ

RESISTANCE analog Output(Only ADD71)
RESISTANCE -5K/0-200K

Getting Started
This chapter will help you get started.It describes the basic functions of the meter.

Front Panel(ADD91)

1) Hz/Duty switch:when test or simulate frequency signal, button hz/duty and select hz/duty function

2) select RPM/DIS Hz switch: Press the button to select a function. A symbol will display to verify your choice.When test RPM, choose the cylinder of engine. when simulate the frequency signal,botton RPM/DIS Hz key, then enter into the mode of voltage adjusting

3) Hold/Back light switch：press it for 2 seconds till the white light on the screen bright .

Date Hold

The **Date Hold** feature stores the last reading in memory

*Press the **HOLD** button once to hold the present reading.

*Press the **HOLD** button again to exit and resume readings.

4) Range switch：

Range select

The range is automatically selected by the meter. But, you can also manually select arrange within a function by pressing the **RANGE** button.

Range Exit

To exit the **RANGE** mode and return to auto ranging .press and hold the **RANGE** button for 2 seconds.

5) REL switch

REL function

Press the zero “REL” function button to zero the display and store the reading as a reference value. Press and hold the button for two (2) seconds to exit this mode.

In the “REL” mode the value displayed is always the difference between the stored value and the present reading .for example .if the reference value is 24.00V and the present reading is 12.50V.the display will indicate-11.50V if

the mew reading is the same as the reference value. The display will be zero.

6) Square Wave Output (Hz/Duty/Voltage Parameter are changeable)： when simulate the signal, rotate these buttons respectlively ,can change the Hz and duty and voltage value .
7) Safety protector
8) Function/Range switch: Turn this switch to select a function or turn the meter OFF.

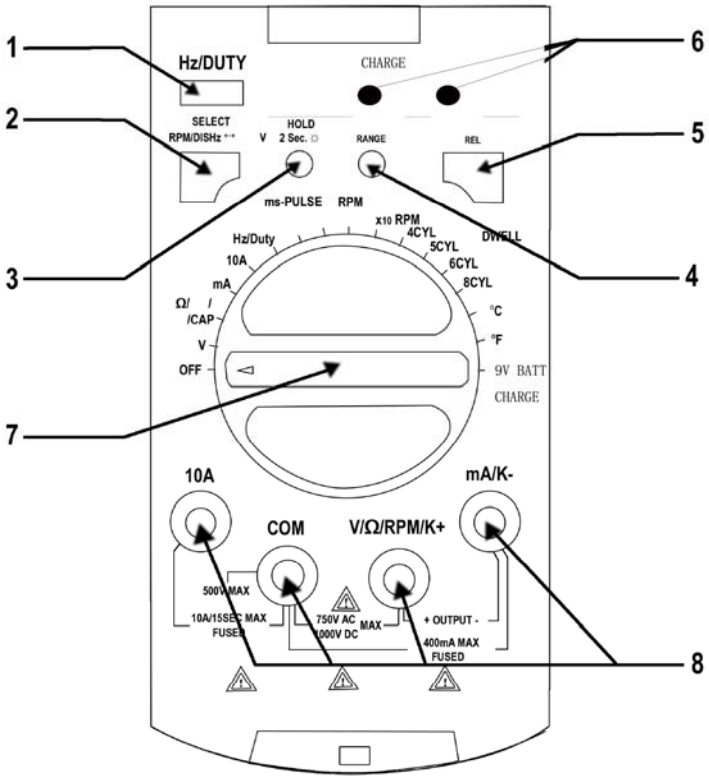
Off: power switch
V： DC/AC voltage test
CAP: resistance /diode/sound/capacitance test
MA (10A) :AC/DC test
Hz/Duty: frequency/duty test
Ms-pulse: injection pulse test
Rpm: engine RPM test
DWELL: dwell of ignition system test
OUTPUT: simulate OUTPUT
C/F: temperature test

9) Test lead terminal: The Black test lead(COM) is used in the Com terminal for all tests. The red test lead(10A /MA AND V/Ω/RPM) is used to measure Amps or Volts

Temperature Terminal（K+ AND k-）: insert the temperature probe in this terminal.

(+OUTPUT-)：The simulating signal OUTPUT jack

ADD81



1） Hz/Duty switch: the switch key test for frequency and duty.

2） RPM/DIS switch: when test RPM, the choosing key of cylinder of engine.，

Hold/Back light switch：press it for 2 seconds till the white light on screen bright.，

Date Hold

The **Date Hold** feature stores the last reading in memory
*Press the **HOLD** button once to hold the present reading.
*Press the **HOLD** button again to exit and resume readings.

4) Range switch is the same as 91
5) REL switch is the same as 91
6) CHARGE INDICATION LIGHT
7) Function/Range switch: Turn this switch to select a function or turn the meter OFF.

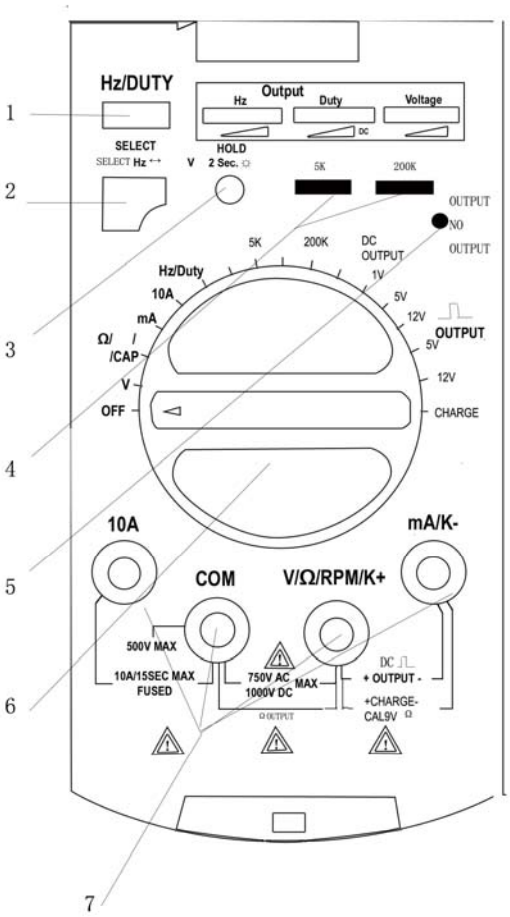
Off: power switch
V： AC/DC voltage test
CAP: resistance /diode/sound/capacitance test
MA（10A）:AC/DC test
Hz/Duty: frequency/duty test
Ms-pulse: injection pulse test
Rpm: engine RPM test
DWELL: dwell of ignition system test
C/F: temperature test
9V BATT CHARGE ： charge function

8) Test lead terminal: The Black test lead(COM) is used in the Com terminal for all tests. The red test lead(10A /MA AND V/Ω/RPM) is used to measure Amps or Volts

Temperature Terminal（K+ AND k-）: insert the temperature probe in this terminal.

+9V CHARGE —：the jack of charger

ADD71



1） Hz/Duty switch is the same as 91

SELECT Hz switch: Press the button to select a function. A symbol will display to verify your choice. 在 when test or simulate frequency signal,press hz/duty switch key, then enter into the mode of voltage adjusting

2） Hold/Back light switch is the same as 91

Date Hold

The **Date Hold** feature stores the last reading in memory

*Press the **HOLD** button once to hold the present reading.

*Press the **HOLD** button again to exit and resume readings.

3） RESISTANCE/HZ/DUTY/V ADJUST: Square Wave Output(Hz/Duty/Voltage Parameter are changeable) when simulate the signal, rotate these buttons respectlively and change the Hz and duty and voltage value .

4） SIMULATOR Signal output control switch：button the switch can control the simulating signal OUTPUT and NO OUTPUT

5） Function/Range switch: Turn this switch to select a function or turn the meter OFF.

Off: power switch

V： AC/DC voltage test

CAP: resistance /diode/sound/capacitance test

MA（10A）:AC/DC test

Hz/Duty: frequency/duty test

5k/200k: resistance simulating function

DC OUTPUT: DC voltage simulating OUTPUT function

Output: frequency signal OUTPUT function

CHARGE ： charge function

6） Test lead terminal: The Black test lead(COM) is used in the Com terminal for all tests. The red test lead(10A /MA AND V/Ω/RPM) is used to measure Amps or Volts

Temperature Terminal（K+ AND k-）: insert the temperature probe in this terminal.

(+OUTPUT-)：the OUTPUT jack of simulating signal

+9V CHARGE —： the jack of charger

Cal 9v : the collating function of resistance value.

NOTE:

The range is automatically selected by the meter. But, you can also select a range within a function by pressing by pressing the range button.

Always select a range higher than you expect the current or voltage to be. Then select a lower range if better accuracy is needed

*if the range is too high, the readings are less accurate.

*if the range is too low, the meter shows OL (over limit)

Push-button Functions

Alternate Function

The altemate function button is “SELECT”. Press it to toggle to the alternate Function (AC, audible and capacitance) shown in blue on the meter face.

AUTO Power Off Disable

To disable the automatic power off function, hold down the “SELECT” button while turning the meter switch form OFF to ON.

Temperature(℃/℉)
The temperature feature will display the data in degrees Celsius (℃) or Fahrenheit(℉)

ee Also:
Meter Functions
*Duty Cycle
*Ms Pulse
Duty Cycle, what is it?

RPM/DIS
In the RPM function the meter defaults to RPM (1) for conventional 4-cycle engines.
Press the RPM/DIS button to toggle to RPM (1) for 2-cycle engines or waste spark(DIS)4-cycle engines.

Meter functions
Meter functions -voltage (V)
The meter will automatically select the best voltage(V) range.
Press “SELECT” button to select AC or DC.

Insert:
*black lead in COM terminal.
*red lead in V/Ω/RPM terminal .

Touch the Black probe to the circuit coming from the power source.

Touch the Red probe to the circuit coming from the power source.

IMPORTANT: voltage must be measured in parallel (red

probe measuring circuit from power source).

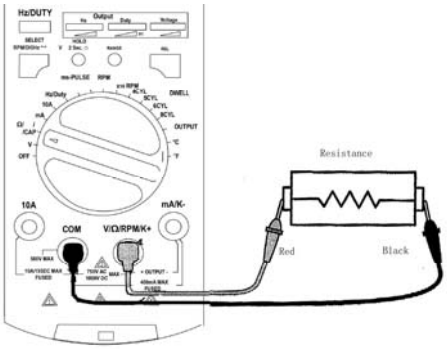
Accuracy

Selection of a lower range will move the decimal point one place and increase the accuracy of the reading .An OL (Over limit) display means the range is too low .select the next higher range.

Meter Functions Resistance(Ω)

IMPORTANT: if you are testing an application that has capacitors in the circuit. be sure to turn the power OFF on the test circuit and discharge all capacitors. Accurate measurement is not possible if external or residual voltage is present.

Select the resistance (Ω) setting with the rotary switch.
Select the **resistance** (Ω) range with the button labeled "RANGE " if a more accurate measurement is desired.



Insert:
*Black lead in COM terminal.
*Red lead in **V/Ω/RPM** terminal.
NOTE:
The resistance in the test leads can affect accuracy at the 400 range. Short the leads together and press the "REL" button to

automatically subtract the lead resistance form the resistance

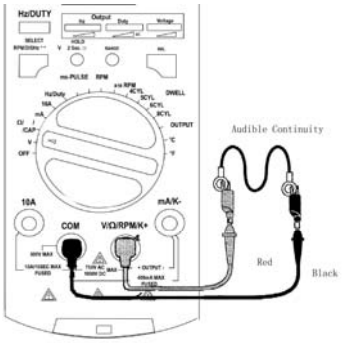
measurements.
Touch the test lead probes across the resistor to be tested.

Meter Function: Audible Continuity

IMPORTANT: Turn the power OFF on the test circuit

Select the **Audible continuity** range with the rotary switch.

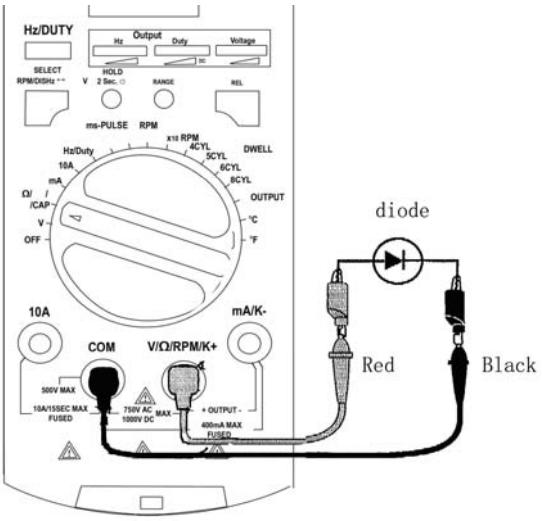
Press “SELECT” button to select **Audible continuity.**



Insert:
*Black lead in **COM** terminal.
*Red lead in **V/ Ω /RPM** terminal.
Connect one test probe to each end of the circuit to be tested.
*circuit complete, the meter will beep
*circuit open, these is no “beep” and the display shows “OL”

meter functions- Diode check

IMPORTANT: Turn the power off to the test circuit



Select the **diode Check( )**setting with the rotary switch.

Insert:

*Black lead in **COM** terminal.

*Red lead in **V/ Ω /RPM** terminal.

Touch the Black test probe to the negative(-) side of the diode.

Touch the Red test probes to the positive (+) side of the diode.

Reverse the probes: Black to the positive(+) side and Red to the negative(-) side.

NOTE:

A"good" diode will read low in one direction and high in the other direction when the probes are reversed (or vice versa).

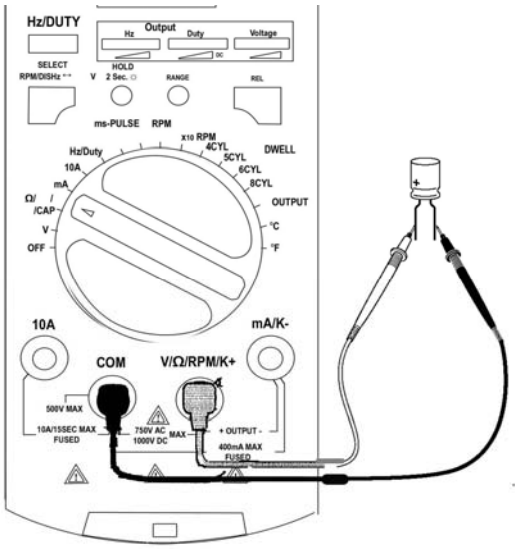
A defective diode will have the same reading in both directions or read between 1.0 to 3.6V in both directions.

Meter functions- Capacitance

IMPORTANT: turn the power OFF to the vehicle circuit to be tested. Discharge the capacitor leads together. Use the DC volts function to confirm that the capacitor is discharge.

Select the **CAP** range with the rotary switch.

Press "SELECT" button to select capacitance measurement **CAP**



Insert:

*Black lead in **COM** terminal.

*Red lead in **V/ Ω /RPM** terminal.

NOTE:

*Holding the probes witch your hands may charge the capacitance in circuit and generate a false reading.

*Residual voltage charges on the capacitor. Poor insulation resistance or poor dielectric absorption may cause measurement errors.

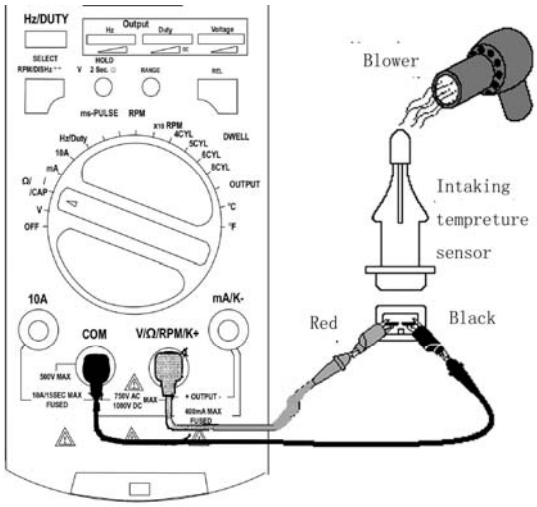
Meter functions - temperature (Temp)

IMPORTANT: to avoid heat damage to the meter; keep it away from sources of very high temperature. The life of the temperature probe is also reduced when subjected to very high temperature (operating range is -50℉ to 2,000 ℉).

Select the ℃ **or** ℉. Setting with the rotary switch.

Insert the temperature probe connector into the **K+** and **K-** socket.

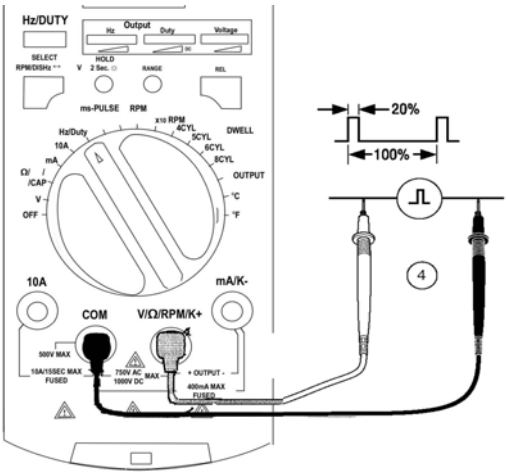
Touch the end of the temperature sensor to the area or surface of the object to be measured.



Meter functions – frequency (Hz)

Select the frequency (Hz) setting with the rotary switch.

Insert:



*Black lead in **COM** terminal.
*Red lead in **V/ Ω /RPM** terminal.

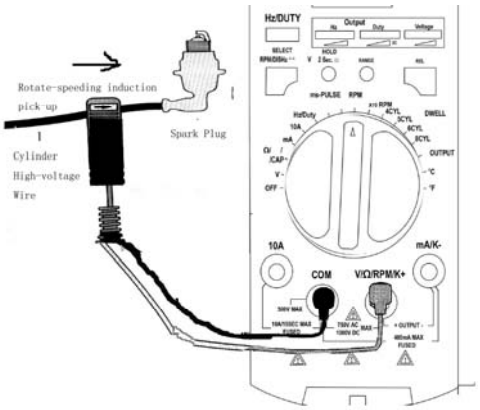
Connect the Black test probe to ground.

Connect the Red test probe to “signal out” Wire of the sensor to be tested.

NOTE:
For frequencies below 1 Hz. the display will show 0.000Hz.

Meter functions –RPM/X10RPM

Select the **RPM** range with the rotary switch.
OR select the **X10RPM** range with rotary switch (4,000 to 12,000RPM). Multiply the displayed reading times ten to get actual RPM.



Insert the induction pick-up connecting terminal into the

meter.

*Ground lead in **COM** terminal.
*output lead in **V/Ω/RPM** terminal.

Connect the inductive pick-up to a spark plug wire. if no reading is received , unhook the clamp, turn it over and connect again.

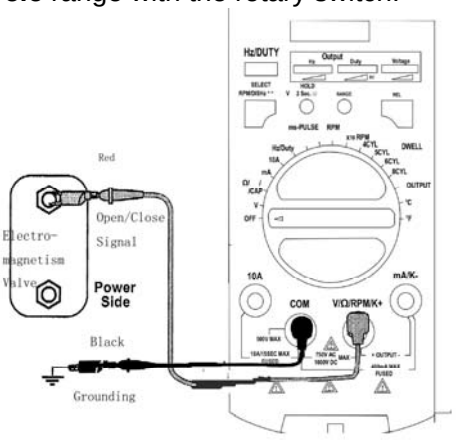
Press the “RPM” button to toggle between RPM 1 for 2 – cycle/Distributor less ignitions system (DIS) or RPM 2 for 4 – Cycle engines.

NOTE:
*Position the inductive pick-up as far away from the distributor and the exhaust manifold as possible.
*Position the inductive pick-up to within six inches of the spark plug or move it to another plug wire if no reading or an erratic reading is received.

Meter functions – Duty Cycle (%)

Select the **% Duty Cycle** range with the rotary switch.
Insert:
*Black lead in **COM** terminal.
*Red lead in **V/Ω/RPM** terminal.

Connect the Black test probe to ground.
Connect the Red test probe to the signal

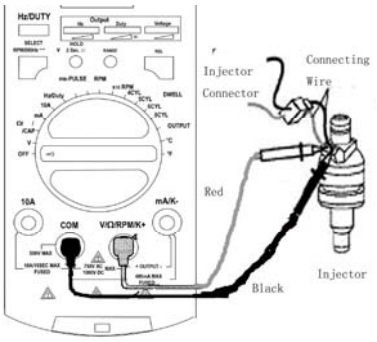


wire circuit.

Meter function –ms pulse

Select the **ms pulse** range with the rotary switch.

Insert:
*Black lead in **COM** terminal.
*Red lead in **V/Ω/RPM** terminal.
Connect the Black test probe to ground.



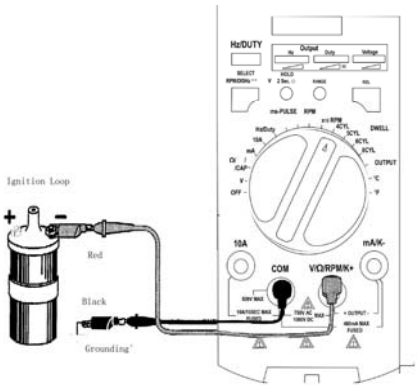
Connect the Red test probe to the signal wire that connects to the component to be measured.

Meter functions – Dwell

Select the **Dwell** range with the rotary switch.
Insert: *Black lead in **COM** terminal.
*Red lead in **V/Ω/RPM** terminal.
Connect the Black test probe to ground.
Connect the Red test probe to the signal wire that connects to the breaker points.

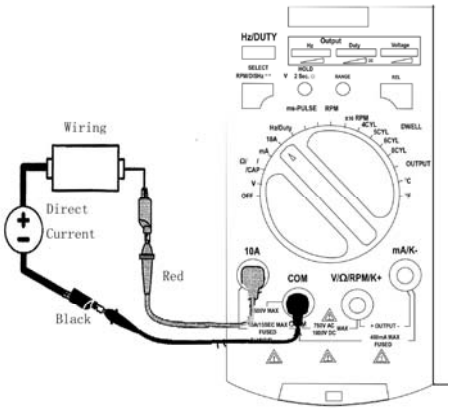
Meter functions –AC or DC current (A)

Select the **10A** or **mA** range with the rotary switch.
Press the “SELECT”



function button to select AC or DC.
Insert:
*Black lead in **COM** terminal.
*Red lead in the 10A or mA **terminal**.

IMPORTANT:



Turn OFF all power to the circuit or disconnect the circuit from the power source.

Connect:
*the Red probe to the side of the circuit closest to the power source.
*the Black probe to the side of the circuit to ground.
*Turn the power ON and test.

NOTE:
Current must always be measured with the meter test probes connected in series as described.

Simulating function

The simulating function of sensor

With the unique sensor simulating function, the instrument can simulate the input signal of sensor to substitute the work of sensor to judge stand or fall of sensor during the process of automotive diagnosis

A D D 91 operation:

The simulating function of voltage signal

The application can simulate voltage signal within 0.5V, such as the signals of TPS /oxygen sensor.

operation:

1. Acquire the standard numerical value of sensor which need to be simulated by learning maintenance manual of original manufactory.
2. Switch off the ignition power and disconnect electronic connector tip.
3 Insert the black lead into the “OUTPUT” socket of the instrument, put its another end to the ground(using the crocodile clip). insert the red lead into the “OUTPUT” socket, connect its another end with the input signal of sensor (can use multi-test leads)
4 **Turn the rotary switch in either direction to select a simulating function of signal “OUTPUT’.**
5 Select the “HZ/DUTY” into Duty Cycle range with the rotary switch. Turn the duty cycle adjusting button to 0000, meanwhile the frequency should be 0000 accordingly.
6 Set the rotary switch to Voltage. Adjust the numerical

value of voltage to standard data prescribed by maintenance manual.

Hint: survey the signal changing of sensor according function of data stream of decoder.

7 Turn on the ignition switch(without starting -up engine)

8 Change the numerical value of simulating signal of sensor, then survey if the data of sensor is consistent with simulating signal through data stream of scanner. If consistent, that means there is no fault in electronic control system.

Start up engine according to the numerical value of simulating signal which needed to change. If the fault of automotive disappear obviously, that means fault exist in sensor.

The simulating function of frequency signal

The application can simulate frequency signal with 0.5V and 10Hz-40k.

:

Operation:

1 Acquire the standard numerical value of frequency sensor which needed to simulate from maintaining manual of original factory.

2 Switch off the ignition power and disconnect the electronic connector tip.

Insert the black lead into the “OUTPUT” socket of the application, put its another end to the ground(using the crocodile clip). insert the red lead

into the “OUTPUT” socket, connect its another end with the input signal of sensor (can use multi-test leads)

Turn the rotary switch in either direction to select a simulating function of signal “OUTPUT’.

Select the “HZ/DUTY” into Duty Cycle range with the rotary switch. Turn the duty cycle adjusting button to 0000, meanwhile, the frequency should be 0000 accordingly.

Caution; adjust duty system firstly, then adjust frequency .If Not knowing the standard numerical value of detailed duty system, you need adjust the duty cycle to 50%.

Set the rotary switch to Voltage. Adjust the numerical value of voltage to standard data prescribed by maintenance manual.(5v)

Hint: survey the signal changing of sensor by learning the data stream of scanner.

Turn on the ignition switch (without starting -up engine)

。

Change the numerical value of simulating signal of sensor, then survey if the data of sensor is consistent with simulating signal through data stream of scanner. If consistent, that means no fault in electronic control system.

Start up engine according to the numerical value of simulating signal which needed to change. If the fault of automotive disappear obviously, that means fault exist in sensor..

.MAINTENANCE

(1) The multimeter is a precision electronic device. Do not tamper with the circuitry. to avoid damage :

A: Never connect a source of voltage under the condition of resistance measurement.

B: Never operate the meter unless the cover is in place and fully closed.

C: Battery replacement should be done after the test leads have been disconnected and POWER IS OFF.

(2) Turn off the power if the meter is not in use, removed the battery if the meter will be free for long period.

(3) If a sign "🔋" appear on the display, open the compartment cover, remove the spent battery and replace it with a battery of the same type.

(4) Contact with the maintenance service center of our company if you have trouble.

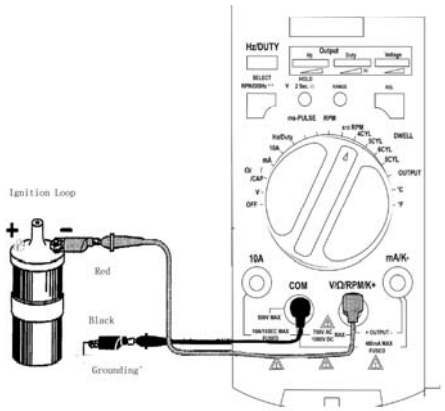
Basic Diagnostic Testing

This chapter leads you through a systematic series of tests

that check the vehicle electrical system. These tests should de performed before testing individual components.

Electrical System Diagnostics

It is important to diagnose a vehicle electrical problem thoroughly and efficiently.



The series of tests that follow check primary areas that are responsible for the majority of the electrical problems found in an automobile. perform these basic tests, even if a vehicle has a trouble code set in the computer .A component malfunction detected by the computer can be caused by a basic ground problem in the electrical system . Simply replacing a failed component will not fix the problem if a poor ground caused the component failure.

The tests begin by checking the main source of power and the chassis ground circuit connections. Ground circuits are one of the least understood but potentially most troublesome areas of automotive electronics. An excessive voltage ground

in a circuit effects the entire electrical circuit. This is why it is important to make sure the basic circuits are in good shape before checking trouble codes and components.

Battery Testing

[1]Battery Test (surface Discharge)

NOTE:

*Remove the positive and negative battery cables and thoroughly clean the cable terminals and the battery posts. Reassemble and begin testing.

*The ignition switch must be OFF to prevent damaging the vehicle computer when connecting or disconnecting battery cables.

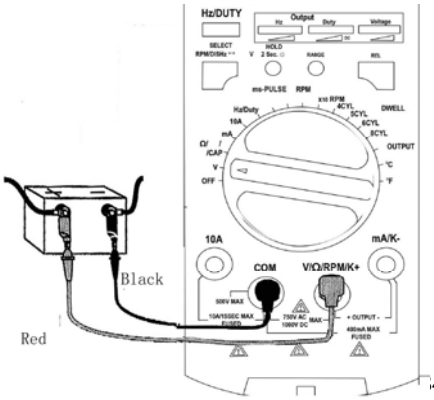
This test checks for a low current discharge across the battery case.

*Set the rotary switch to **voltage.**

*connect the negative (-) lead to the negative battery post.

*Set the Min/Max feature on the meter .

*Touch the positive(+)lead to the battery case around the positive (+) battery post ,Do not touch the post .

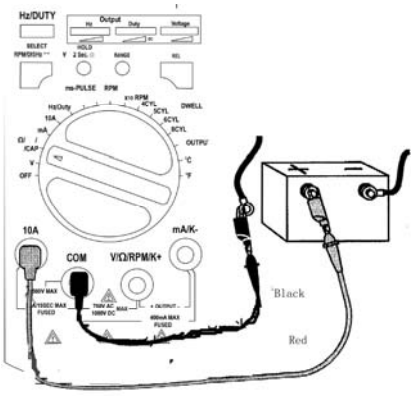


A reading of more than 0.5V indicates excessive surface discharge.

Dirt, moisture and corrosion are a cause of surface discharge .clean the battery

with a baking soda and water solution .do not allow the solution to get into the battery.

[2]Static Battery Test (No Load)



This test checks for battery change state.

• Turn the headlights on for 15 seconds to dissipate battery surface charge.

IMPORTANT: The ignition switch must be OFF when connecting or disconnecting battery cables to prevent damaging the vehicle computer.

• Disconnect the negative (-) battery terminal.

• Set the rotary switch to voltage.

•Connect the positive (+) lead to the positive (+) battery post.

• Connect the negative (-) lead to the negative (-) battery post.

A reading of less than 12.4V indicates an undercharged battery. Recharge before testing.

NO LOAD TEST

Meter Reading	Battery Charge
12.6V	100%

Parasitic draw should not exceed 100mA.

If there excessive draw, remove the circuit fuse, one at a time, until the excessive draw is located. Also check the non-fused applications such as head lights, computer relays and capacitors in the instrument panel.

Reconnect the battery cable for the next test .

12.4V	75%
12.2V	50%
12.0V	25%

NOTE:
Leave the battery cable unhooked and proceed to the test on the following page.

[3] Battery Test (Parasitic Load)

This is for excessive parasitic drain on the battery.
• Turn the ignition switch and all accessories OFF.
IMPORTANT: Do not start the vehicle during this test; meter damage may result.

• Set the rotary switch to 10A.

• Insert the positive (+) lead into the 10A meter terminal.

• Disconnect the battery positive (+) cable .
• Connect the positive (+) lead to the positive (+) battery

terminal.

• Connect the negative (-) lead to the Disconnect positive (+) battery terminal.

• Set the Min/Max feature on the meter.

[4] Battery Test (Load)

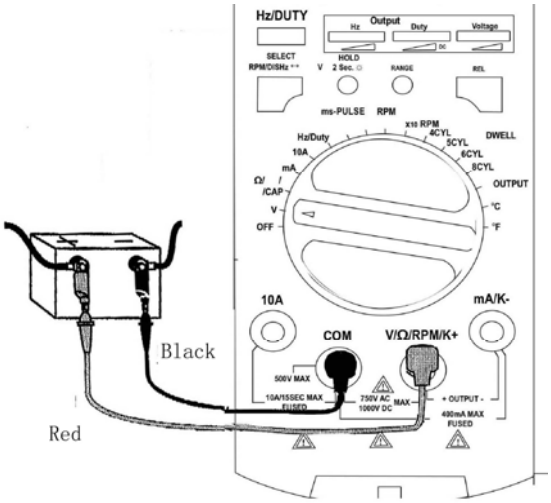
This tests the battery's capacity to deliver sufficient cranking voltage.

• Set the rotary switch to **Voltage.**

•Connect the positive (+) lead to positive (+) battery terminal.

• Connect the negative (-) lead to negative (-) battery terminal.

• Set the Min/Max feature on the meter.



• Disable the ignition; Crank the engine for 15 seconds. Check the Min. display. A reading of less than 9.60V@70° indicates a weak battery. Recharge/replace before testing.

Voltage Load Test

Meter reading	Battery/air temperature
10.0V	90F/33℃
9.8V	80F/27℃
9.6V	70F/21℃
9.4V	60F/16℃
9.2V	50F/10℃
9.0V	40F/4℃
8.8V	30F/-1℃
8.6V	20F/-7℃

NOTE:
• For each 10℉ above or below 70℉, add or subtract 0.2 volt.
• Battery temperature can be checked with the meter temperature probe.

Resistance, what is it?
Resistance is an opposing force, created by a circuit or component, to the flow of electrical current.

There is a small amount of natural resistance when voltage flows though wires, switches, grounds or connections. The resistance increases beyond acceptable limits if corrosion

develops, fittings become loose or wire fray. Resistance Increases each time something, such as wire, a switch, connections, or the ground are added in the circuit.

Voltage Drop, What is it?
Voltage drop is the difference in voltage potential when measured across a circuit or component creating resistance.

The resistance decreases the amount of voltage available. The bulb will not light or the motor will not turn if the voltage is too low.

Maximum Voltage Drop

Maximum voltage drop should not be more than 0.1 volt per wire, ground, connection, switch or solenoid.

What should be tested?
Each wire, ground, connection, switch solenoid and the complete circuit should be tested. Each connection point is a potential source of increased resistance.

Voltage Drop Testing

[1] Negative (-) Engine Ground
This test checks for engine ground efficiency.
• Set the rotary switch to **Voltage.**

• Touch the positive (+) lead to the positive (+) battery post and the negative (-) lead to the negative (-) battery post. Note the reading…this will be the base voltage to compare your test voltage reading against.

• Connect the positive (+) lead to a clean spot on the engine

block.

• Connect the negative (-) lead to the negative battery post.

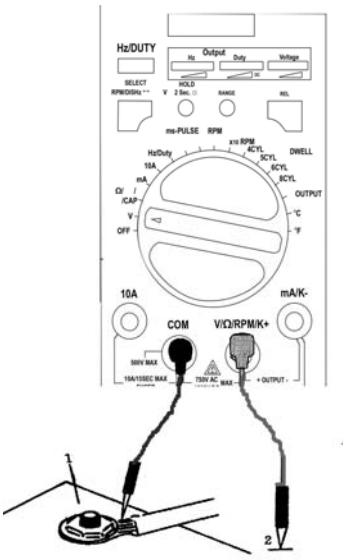
• Set the Min/Max feature on the meter.

• Disable the ignition so the engine doesn't start; Crank the engine for 2-3 seconds.

The example shown has 2 connectors, 1 wire, 1 ground and 1 terminal to battery post. A voltage drop of more than 0.5 volts would indicate a poor ground circuit.

Clean and inspect the battery cable connections test and the ground; test again.

Important: Repeat this test when the engine is thoroughly warmed up. Heat expansion of metal may cause resistance to increase.



[2] Negative (-) Chassis Ground

This test checks for chassis ground efficiency.

• Set the rotary switch to **Voltage.**

• Establish the base voltage that you will compare test voltage against (see base voltage, Volt Drop Test [1]).

• Connect the positive (+) lead to the point on the fender, fire wall or vehicle frame where the accessory ground is fastened .

• Connect the negative (-) lead to the negative battery terminal.

• Set the Min/Max on the meter .

• Turn all of the accessories ON (bright lights, A/C fan –high ,rear window defroster, windshield wipers ,etc.).

• Disable the ignition so the engine doesn't start ; Crank the engine for 2-3 seconds.

The example shown has 2 connectors, 1 wire, 1ground and 1 terminal to battery post. A voltage drop of more than 0.5 volts would indicate a poor ground circuit.

Clean and inspect the battery cable connections and the ground; test again.

[3] Battery Power to Starter Solenoid (+)

This test checks battery source efficiency to the starter solenoid.

• Set the rotary switch to **Voltage .**

•Establish the base voltage that you will compare test voltage against (see base voltage , Volt Drop Test [1]).

• Connect the positive (+) lead to the positive (+) battery

terminal.

• Connect the negative (-) lead to the positive (+) terminal on the starter solenoid .

• Set the Min/Max feature on the meter .

• Disable the ignition so the engine doesn't start ; Crank the engine for 2-3 seconds.

The example shown has 2 connectors and 1 wire, a voltage drop of more than 0.3 volts would indicate a poor ground circuit.

Clean and inspect the battery cables and cable connections; test again.

(图 1) Important :Repeat this test when the engine is thoroughly warmed up .Heat expansion of metal may cause resistance to increase.

[4] Battery Power to Complete Starter Circuit (+)

This test checks battery power efficiency to the starter through the starter solenoid.

• Set the rotary switch to **Voltage .**

•Establish the base voltage that you will compare test voltage against (see base voltage, Volt Drop Test [1]).

• Connect the positive (+) lead to the positive (+) battery terminal .

•Connect the negative (-) lead the positive (+) terminal on the starter motor .

• Set the Min/Max on the meter .

• Disable the ignition so the engine doesn't start ; crank the engine for 2-3 seconds.

The example shown has 4 connectors and 2 wire, and 2 solenoid connections .A voltage drop of more than 0.8 volts would indicate a poor ground circuit.

Clean and inspect the battery and starter cables, solenoid and cable connections; test again.

Note: A defective starter solenoid may cause an excessive voltage drop; check the cables and connections before replacing the solenoid.

Starter Motor Testing

[1] Starter – Current

The battery tests and the voltage drop tests have verified that there is adequate battery voltage at the starter. Next, check for excessive starter motor current draw.

• Connect a current clamp around the negative (-) or positive (+) battery cable .
• Set the rotary switch to the **400mV** setting.
NOTE: 1mV=1Amp.

• Set the Min/Max feature on the meter, the Min reading will

be the negative current draw .

• Disable the ignition so the engine doesn't start ; Crank the engine for 2-3 seconds.

NOTE:
The current clamp measures amps in the direction of electrical flow. Make sure the arrow on the clamp is pointed in the direction of the current flow in the cable.

Quick Test
Turn the ignition and all accessories OFF, Place the clamp on the battery cable, then turn the headlights on. If the reading is not negative, disconnect the clamp, turn it over and reconnect.

Approximate Average Draw

4Cyl	150-180 Amp, Maximum
6-8Cyl, Under 300 CID	180-210 Amp, Maximum
6-8Cyl, Over 300 CID	250 Amp, Maximum

Charging System Tests

[1] Battery (+)
This test checks for alternator output voltage at the battery.

• Set the rotary switch to **Voltage .**

• Connect the positive (+) lead to the positive (+) battery terminal.

• Connect the negative (-) lead to the negative (-) battery

terminal.

• Set the Min/Max feature on the meter.

• Mark sure all vehicle accessories are turned OFF.

• Start the engine and hold at 1500RPM.

A reading of 13.1-15.5 volts is an acceptable charging rate, If the voltage is low check for:

• Loose, cracked, or glazed drive belt .

• Loose or faulty wires or connectors.

• Defective alternator or regulator. See [2] Alternator Voltage Output (+), Loaded.

[2] Alternator Voltage Output (+), loaded

This test checks for alternator output voltage. This test is necessary only if the vehicle failed [1] Battery (+) test.

• Set the rotary switch to the Voltage setting.

• Connect the positive (+) lead to the battery (B+) output post on the back of the alternator.

• Connect the negative (-) lead to the negative (-)battery terminal.

• Set the Min/Max feature on the meter.

• Start the engine and hold a 1500RPM.

A reading of 13.1-15.5 volts is an acceptable Charging rate.

[3] Alternator Amperage (A) Output, Battery

This test checks for alternator charging rate efficiency at the battery.

• Connect currents Clamp (RPM-100, option) leads to the meter .

• Connect the Current Clamp around the negative (-) or positive (+) battery cable .

• Set the rotary switch to the Voltage setting .
NOTE: 1mV=1Amp
• Mark sure all vehicle accessories are turned OFF.

• Start the engine and hold at 1500 RPM.

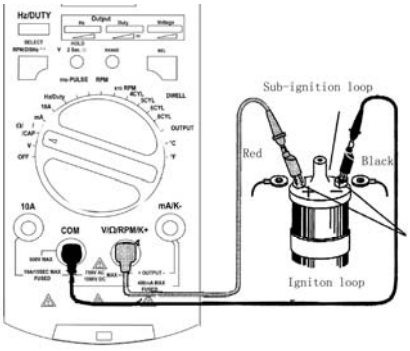
The Amperage reading should be 5 amps or better.

NOTE:
The current clamp measures amps in the direction of electrical flow. Make sure the arrow on the clamp is pointed in the direction of the current flow in the cable.

Quick Test:
Place the clamp on the battery cable, then turn the headlights on. If the reading is not negative, disconnect the clamp, turn it over and reconnect.

Ignition System Tests

[1] Ignition Coil, Primary Resistance Test,
for checking primary winding sistance.



MPORTANT: Test the ignition coil cold and hot.
• Set the rotary switch to the Resistance (Ω) setting.

INSERT:
• Black lead in COM terminal.

• Red lead in V/ Ω RPM terminal.

• Disconnect the coil from the vehicle wiring harness.

• **NOTE**:
The resistance in the meter leads must be subtracted to get an accurate measurement at the 0.50-2.0 range. Short the leads together and press the ZERO △ Button . The meter will automatically subtract the resistance in the leads.

• Connect the negative (-) lead to the negative (-) terminal on the coil.

•Connect the positive (+) lead to the positive (B+) terminal on the coil.

Typical measurements are between0.50-2.0 Ω's consult the manufacturer's specifications for required resistance measurements.

[2] Ignition Coil , Secondary Resistance Test (Ω)
This test checks secondary winding resistance.

IMPURTANT: Test the ignition coil cold and hot
.
• Set the rotary switch to the Resistance (Ω) setting .

INSERT:
• Black lead in COM terminal .

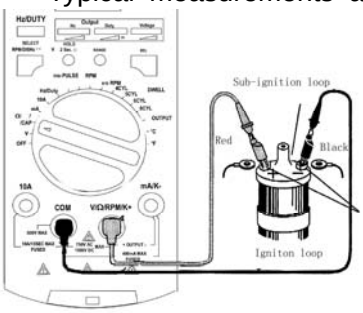
• Red lead in V/Ω RPM terminal .

• Disconnect the coil from the vehicle wiring harness .

•Connect the negative (-) lead to the high tension terminal on the coil .

• Connect the positive (+) lead to the positive (B+) terminal on the coil.

Typical measurements are between 6000-30000's Consult the manufacturer's specifications for required resistance measurements.



[3] Secondary Ignition Wire

Resistance Test (Ω)

This test checks for open circuits or high resistance in the secondary (sparkplug) wires.

IMPORTANT: Twist and bend the sparkplug wire while measuring the resistance for this test.

• Set the rotary switch to the Resistance (Ω) setting.

INSERT:
• Black lead in **COM** terminal.

• Red lead in **V/Ω/RPM** terminal.

• Connect the test probes to opposite ends of the sparkplug wire.

• Set the Min/Max feature the meter.

Typical measurements are approximately 1.000Ω's per inch of wire . For example, 10 inch cable=10.000Ω.

[4] Distributor Cap/Rotor Resistance Test (Ω)

This test checks for open circuits or high.
Resistance in the distributor cap and rotor.

• Set the rotary switch to the **Resistance (Ω).**
INSERT:
• Black lead in **COM** terminal.

• Red lead in **V/Ω/RPM** terminal.

Dist. Cap Center Connector Test:
Connect the test probes to opposite ends of the distributor cap terminal (see illustration).

In general, resistance (Ω) should be 5k-10k. Refer to the manufacturer's specifications.

Rotor Test:
Connect the test probes to opposite ends of the rotor contacts (see illustration).

In general, resistance should be 0.1(Ω) or less. Refer to the Manufacture's specifications.

[5] Pick-up Coil Resistance (Ω)/Voltage Test (V)

• The Resistance test checks for open circuits or high resistance.

• The Voltage test compares voltage output to resistance.

Test Procedure
• Set the rotary switch to the **Resistance(Ω).**
INSERT:
• Black lead in **COM** terminal.

• Red lead in **V/Ω/RPM** terminal.

• Connect the test probes to the pick-up coil lead (see illus).

Resistance Specifications

The majority of the pick-up coils will test between 500-1500 Ω's resistance. See manufacture's specification for required range.

• Set rotary switch to **volts.** Press the Blue, Alternate Function button to select AC.

• Crank engine 10-15 seconds at normal speed; measure voltage.

Resistance Test/Voltage Output

Resistance(Ω) on a "good "pickup coil will match AC output voltage (Ex.,950 Ω's=950mV output). Resistance can be good but voltage low if the magnet has lost magnetism or if the reflector is too far from the stator (Airgap).

[6] Hall Effect Sensor Voltage Test (V)

This test checks for switching action in any hall Effect sensor (Ignition, RPM, Crankshaft, etc.)

• Set the rotary switch to the **Voltage (V)** position.

INSERT:

• Black lead in **COM** terminal.

• Red lead in **V/Ω/RPM** terminal.

• Set the Min/Max feature on the meter.

• Connect the Black test probe to the negative (-) post on the battery.

•Turn the ignition key ON. Touch the Red (+) test probe to the three test point shown.

• Ground reading should be the same voltage as the ground (Computer or battery).

• Supply line reading should be the same voltage as the input source (Computer or battery).

• **Signal line** reading should be 0 or the same voltage as the input source (Computer or battery). The reading will toggle high and low as the shutter rotates.

Basic Diagnostic Testing

This chapter describes a computer controlled sensor and actuator system typically Found on today's automobile.

Test procedures are also provided for the basic ground of electrical input and output components commonly found in a computer controlled automotive system. The test procedures are, due to the complexity of components, general theory tests. Be sure to consult the vehicle service manual for component schematics and test specifications.

Computer Controlled Systems

A need for better fuel economy and lower emissions resulted in today's automobiles utilizing computer controlled functions that were previously activated by mechanical, Electrical and vacuum devices.

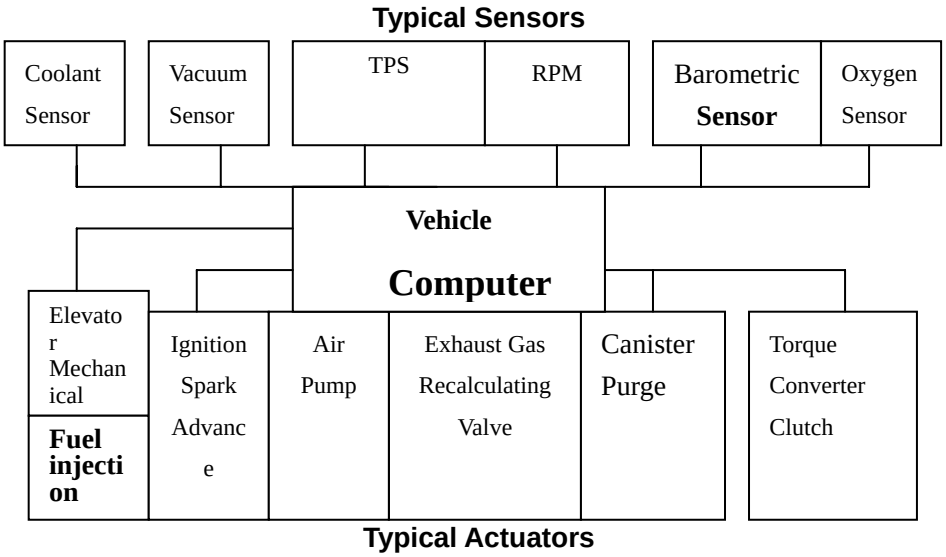
Computerized vehicle control systems are made up of three basic component groups. These groups are:

1. **Sensors:** they are input devices that supply information

about engine operating conditions and the surrounding environment to the vehicle computer.

2. Engine Control Module: a vehicle computer that processes the information supplied by the sensors then sends an electronic command to the appropriate components actuators.

3. Actuators: these are output devices that may be electrical, mechanical or vacuum components controlled by the vehicle computer.



Basic Diagnostics for the computer Controlled Engine

There are two important steps that must always be followed

when diagnosing and repairing vehicles with computer controls.

• Do basic engine diagnostics first .Many problems can be traced to lack of routine maintenance on components such as plug wires, filters and spark plugs . Also check for vacuum leaks on any vehicle, new or old, A completes engine diagnosis should precede any electrical system diagnostics.

• Follow the published diagnostic Charts Exactly through every step to mark a repair on computer component.

Self-Diagnostic Computer Systems

One of the functions of the vehicle computer is to record fault codes produced when a sensor or actuator fails. These failures are usually displayed as a “Current Code” or as an “Intermittent Failures”. Be aware, however, that some vehicle manufacturers use different terminology and older vehicles do not have all of ground of codes described.

Current Codes are faults that are active.

• **Hard Failure** causes the dash “check engine” light to remain ON.

• Intermittent Failure causes the dash “check engine” light to flicker and then go OFF after a short period of time. Generally the trouble code stays in the computer memory.

History Codes are stored codes for faults that have occurred in the past.

Failure Codes

When a failure is detected be the computer, it stores the information in the form of “Fault Codes” (also known as Trouble Codes or Service Codes). These Fault Codes are usually a two or three digit number that identifies the electrical circuit affected. Once these codes have been

read the vehicle repair can be stares. Be sure to closely follow the vehicle service manual diagnostic procedures, repairs and specifications.

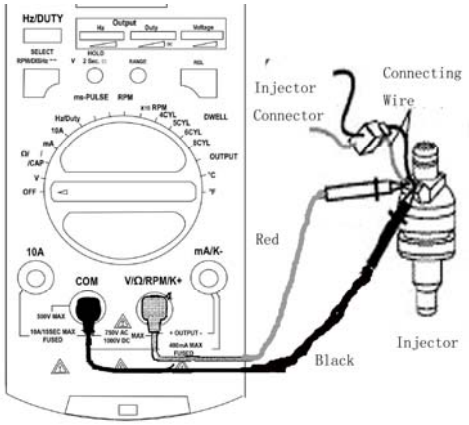
Component Testing

Component testing with a meter generally requires detailed schematics and specifications that are provided by the manufacture. The following section provides general information for the main groups of sensors (input) devices and actuators (output) devices.

The primary input devices (sensors) are:

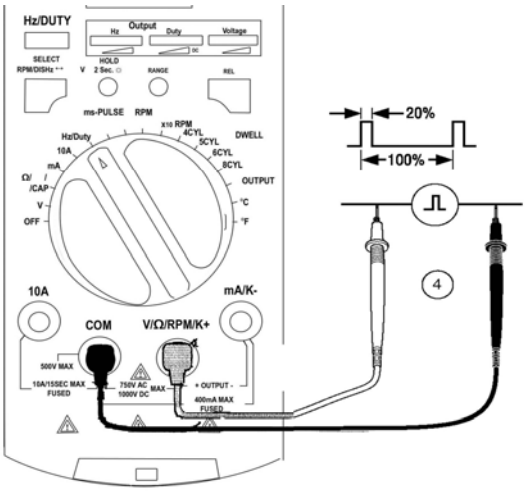
- Temperature sensors
- 2-wire devices
- 3-wire devices
- Oxygen sensor
- pressure sensors

Primary output devices (actuators) are a form of an electromagnet that is either ON or OFF. The ON/OFF signal, in general, will be in one of three configurations:

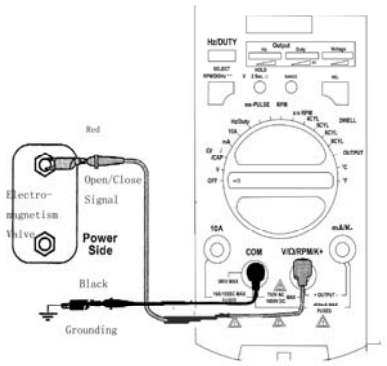


- ON of OFF only (switch)
- Pulse width in a specified length of time (fuel injector)
- Duty cycle measured in percent of high or low time or dwell degrees (mixture control solenoid)

Duty Cycle, What is it ?



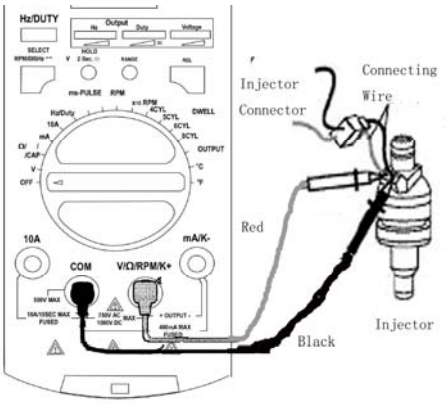
Duty cycle is the **percentage (%) of time** a voltage is positive compared to negative: ON compared to OFF. For example; duty cycle measurements are used for Mixture control solenoids. The amount of ON time is measured as a percent of the total ON/OFF cycle. The meter can read the negative (-) or positive (+) slope and display it as a percent (%) of the total cycle.



Frequency (Hz), What is it?

Frequency is the number of times a voltage pattern repeats positive compared to negative: ON compared to OFF, during one (1) second of time. For example: frequency (Hz)

measurements are specified for digitally controlled manifold Absolute Pressure sensors. The frequency of the ON/OFF signals per second are measured and displayed. Frequency (Hz) is shown as **Analog**: A continuous positive to negative cycle; or **Digital**: A positive to negative/ON to OFF cycle.



Pulse Width. What is it?

Pulse width is the **length of time** an actuator is energized. For example; fuel injectors are activated by an electronic pulse from the engine control module. This pulse generates a magnetic field that pulls the injector nozzle valve open. The pulse ends and the injector nozzle is closed. This “open to close” time is the pulse width and is measured in milliseconds (mS).

Typical Port fuel injectors (TBI) operate with a single ON to OFF electrical pulse.

Typical Port Throttle Body injectors (TBI) operate with an ON to HOLD to OFF electrical pulse. This method creates a double electrical “spike”. An oscilloscope is required to measure this type of pulse.

Component Tests (input)

[1] Temperature Tests

Many components that regulate temperature can be tested be measuring the surface temperature of the area surrounding the component.

- Connect the temperature probe to the meter.
- Set the rotary switch to the **Temperature** position.
- Set the Min/Max feature on the meter.
- Touch the end of the temperature probe directly to the surface of the component to be tested.

Compare your readings with the manufactures Specifications. The temperature should be within ±10℉(±5℃) of the data stream Values.

Some of the components that can be tested for Temperature variation are:

- Radiators
- Transmission
- Heaters
- A/C Condensers
- A/C Evaporators
- Engine Coolant Sensors
- Air Temperature Sensors

[2] Thermistor (Variable Resistance, 2-wire) Tests

Thermistors are variable resistors that are sensitive to temperature level changes. As the temperature changes, the thermistor's resistance value changes.

- Select the **Ohms** (Ω) range the rotary switch .
- Connect the test probes to the sensor terminals.

The Ohms reading should match the temperature of the sensor (see manufacturer's specifications).

Typical thermistor applications are:

- Engine Coolant Temp. (ECT)
- Air Charge Temp. (ACT)

- Manifold Air Temp. (MAT)
- Vane Air Temp. (VAT)
- Throttle Body Temp. (TBT)

Voltage Presence

- Disconnect the vehicle wiring harness at the sensor.
- Select the Voltage range with the rotary switch.

Insert:

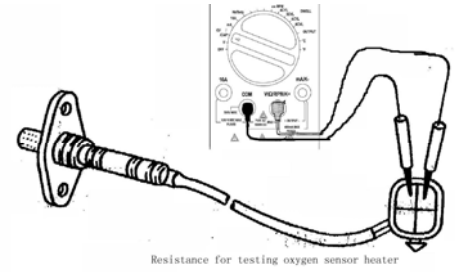
- Black lead in COM terminal.
- Red lead in V/Ω/RPM terminal.
- Connect the test probes in parallel:
  positive (+) to the circuit coming from the power source,
  negative (-) to the negative circuit from the sensor.
- Turn the ignition switch ON; do not start 10 the engine.

Measurement should be 5-9 volts (check the manufacture's specifications).
Voltage Change Connect jumper wires between the connector and the sensor.

- Connect the test probes in parallel:
  Positive (+) to the circuit coming from the power source,
  negative (-) to the Negative circuit from the sensor.
- Start the engine.
- Set the Min/Max feature on the meter.

The voltage should change as the temperature changes. This is the signal that is sent to the computer for processing. Refer to the manufacturer's specifications. If the voltage change is not within specifications, look for sources of resistance due to poor connectors, connections or breaks in the wiring.

[3] Potentiometers (Variable Resistance, 3-wire) Tests


Resistance for testing oxygen sensor heater

The potentiometer is a variable resistor. The signal it generates is used by the vehicle computer to determine position and direction of movement of a device within the component.

Resistance

- Set the rotary switch to the Resistance (Ω) setting.
- Disconnect the sensor.
- Connect the test probes to the signal line and to the ground (refer to manufacturer's schematic).
- Set the Min/Max feature on the meter.

Watch the bar graph display; the Ohms reading should change as the signal arm on the potentiometer is moved (signal sweep).

Typical potentiometer applications are:

- Throttle position Sensor (TPS)
- Exhaust Gas Recirculation valve position Sensor (EVP)
- Vane Flow Meter(VAF)

Potentiometers (Variable Resistance, 3-wire) Tests

Reference Voltage Test

- Disconnect the vehicle wiring harness at the sensor.
- Select the Voltage range with the rotary switch.

Insert:

- Black lead in COM terminal.
- Red lead in V/Ω/RPM terminal.
- Connect the test probes in parallel:
  Positive (+) to the computer reference voltage circuit,

negative (-) to the negative system ground circuit from the sensor.

• Turn the ignition switch ON : do not start the engine.

Watch the bar graph display. Reading should be 5-9 volts (check the manufacturer's specifications).

Potentiometers (Variable Resistance, 3-wire) Tests

Voltage Change

• Connect jumper wires between the connector and the sensor.

• Connect the test probe in parallel:

Positive (+) to the signal line, negative (-) to the ground circuit.

• Turn the ignition key ON, do not start the engine.

• Set the Min/Max feature on the meter. Observe the bar graph display. The voltage drop should change as the position of the signal arm on the potentiometer moves (signal sweep).

Refer to the manufacturer's specifications. If the voltage change is not within specifications, look for sources of resistance due to poor connectors, connections or breaks in the wiring.

[4] Oxygen Sensor (02) Test

The Oxygen sensor samples the amount of Oxygen in the exhaust stream. The voltage produced by the 02 sensor is a direct ratio to the oxygen level in the exhaust stream this voltage is used by the computer to change the air/fuel mixture.

This test will check oxygen sensor signal output levels.

•Disconnect the vehicle wiring harness at the sensor. Install a jumper wire.

• Select the voltage range with the rotary switch.

Insert:

- Black lead in COM terminal.
- Red lead in V/Ω/RPM terminal.
- Connect the test probes in parallel:

Positive (+) to the jumper wire, negative (-) to the engine ground.

- Set the Min/Max feature on the meter.
- Vehicle engine must be running at operating temperature (fast idle at 2000RPM for two minutes).

Voltage readings should move between 0.2(lean) and 0.8 (rich). The average DC voltage should be around 0.50.

[5] Pressure sensor Test

The electrical tests for pressure sensor such as the Manifold Absolute Pressure (MAP) and Barometric Pressure (BARO) vary greatly, depending upon type and manufacturer, consult the vehicle service manual for the schematic, specifications and test procedures.

General Testing Procedures

Note : You cannot do a resistance (Ω) test for pressure sensors.

Analog Sensor

An analog sensor can be tested with the same series of voltage (V) tests suggested for 3-wire potentiometer voltage tests. In place of “sweeping” the sensor, a vacuum pump is generally used to vary the pressure on the sensor. In all cases, refer to a vehicle service manual for the correct procedure.

Component Test (Output)

Output Devices

The electrical tests for output devices vary greatly, depending upon type and manufacturer. Consult the vehicle service manual for the schematic, specifications and test procedures. Primary output devices (actuators) are from of an electromagnet that is either ON/OFF. The ON/OFF signal, in general, will be in one of three configurations:

• **ON/OFF only (switch)** check for continuity with the switch in the ON and OFF position.

• **Pulse width (fuel injector)** measure the ON time (pulse).

• **Duty cycle (Mixture Control Solenoid)** measure the percent of high (+) or low (-) time in a duty cycle. In most cases the low (-) time is the on time.

Maintenance Fuse and Battery Replacement

⚠ **WARNING:**

• Avoid electrical shock; Remove test leads before opening case.

• Do not operate the meter or rotate the meter switch when the case is open.

1. To replace a battery or fuse, loose the three screws in the case back and remove the case by lifting up and forward.

• Replace the battery with an 9 volt alkaline battery.

2. To replace fuse, firmly grasp the printed circuit board (PC boards by the edges and lift up and out of the case.

IMPORTANT:

•To prevent contamination of the circuits, your hands must be clean and the printed circuit board must be help by the edges.

• Replace the fuse with the same type of fuse.

◎20A is a F20A ,500V high energy, fast acting fuse.

◎ mA is a F500mA, 250v high energy, fast acting fuse.
• Mark sure the replacement fuse is centered in the fuse holder.
3.Carefully re-insert the PC boards into the case. Re-assemble the case, then fasten the three screws.

Trouble Shooting

1. Meter will not turn ON.
• Check the battery contacts for a tight fit.
• Check for a minimum battery voltage of 8.0 volts.
• Mark sure the battery wire, are not pinched in the cafe.
2. Ampere reading is erratic or there is no reading at all.
• Disassemble the meter back cover and test the fuses for continuity.

3. Meter reading is erratic.
• Printed circuit board contaminated from handling with hands.
• Low battery.
• Open circuit in a test lead (frayed or broken wire).
• Wrong range selected.
• For frequencies below 1Hz, the display will show 00.00Hz.
• “Blown” fuse.
4. Meter reading do not change.
• “Hold” feature is still toggled ON.